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METHOD FOR ESTABLISHING A VIRTUAL PATH CAPABILITY IN A FRAME RELAY NETWORK

Technical field

The present invention relates generally to the Frame Relay networks and in particular to a method for establishing a Virtual Path capability in a Frame Relay network.

Background

The purpose of a Frame Relay network is to provide an end user with a high speed Virtual Private Network (VPN) capable of supporting applications with large bit rate transmission requirements.

First, a frame relay system must provide services to delimit and align frames on the channel by using flags identifying the beginning and ending of a frame. Secondly, the frame relay system must support virtual circuit multiplexing and demultiplexing through the use of a Data Link Connection Identifier (DLCI) in the frame. Such a DLCI identifies a virtual connection on the channel at a user to network or network to network interface. Consequently, a DLCI specifies a data link layer entity to/from which information is delivered/received and which is to be carried in frames by data link layer entities. The DLCI field may be either unstructured or structured. A structure to DLCI field may be established by the network at the user to network interface or at a network to network interface subject to negotiation or bilateral agreement.

In the example illustrated in FIG.1, a source user 10 wants to communicate with a destination user at address 64.2.3.4. Router 12 which receives the traffic to this destination looks up its routing table and sees that this address is mapped with

DLCI 27. It puts the contents in the frame and indicates the DLCI 27 before sending this frame over Frame Relay network 14. The frame is received by a first switching node 16 which maps with its routing table to the DLCI 992 and relays the frame to a second switching node 18. Then, this second switching node maps to the DLCI 35 and sends the frame to router 20 which forwards finally the frame to destination user 22 at address 64.2.3.4 stored in the user payload contained in the frame without any changes within the Frame Relay network.

As described above, the DLCIs are pre-mapped to a destination. The switching nodes inside the network consult their routing table and route the traffic to the proper output port. Therefore, different DLCIs are required to establish different virtual circuits from a switching node in the network even though all this virtual circuits are connected to a same switching node over a single trunk. As the DLCI field has in most implementations only 10 bits and most of the bit combinations are reserved or used for the user information, there are few DLCIs available. Furthermore, connectionless operations could be implemented inside the network with the requirement that the frames arrive at the right port designated by the destination identification.

Summary of the invention

Accordingly, the object of the invention is to achieve a method enabling several virtual circuits using the same trunk between two switching nodes of a Frame Relay network to have a single Data Link Connection Identifier (DLCI).

Another object of the invention is to achieve a protocol enabling several virtual circuits using the same trunk between two switching nodes of a Frame Relay network to be aggregated in a single virtual path.

The invention relates therefore to a method for establishing a Virtual Path (VP) capability in a Frame Relay network wherein frames are transmitted over a plurality of virtual circuits from a first switching node to a second switching node, this method consisting in transmitting from the first switching node to the second switching node a control message with a Data Link Connection Identifier (DLCI) having a predetermined value, the control message defining a virtual path aggregating at least two ones among the plurality of virtual circuits and containing the identification of the virtual circuits aggregated in the defined virtual path.

According to a specific aspect of the invention, the control message includes a field (VCID) containing one byte for the identification of each virtual circuit aggregated in the virtual path and a portion containing a Source Virtual Circuit IDentifier (SVCID) field corresponding to the input adapter used by the virtual circuit in the first switching node, a Source Port IDentifier (SPID) field corresponding to the input port used by the virtual circuit in the first switching node, a Destination Virtual Circuit IDentifier (DVCID) field corresponding to the output adapter used by the virtual circuit in the second switching node and a Destination Port IDentifier (DPID) field corresponding to the output port used by the virtual circuit in the second switching node.

Brief description of the drawings

The above and other objects, features and advantages of the invention will be better understood by reading the following more particular description of the invention in conjunction with the accompanying drawings wherein :

- Fig. 1 represents a block-diagram of a Frame Relay network showing a virtual circuit established between a source user and a destination user.

- Fig. 2 represents a block-diagram of a Frame Relay network wherein several virtual circuits established between a first switching node and a second switching node have been aggregated in a same virtual path according to the method of the invention.
- Fig. 3 represents schematically a diagram showing the protocol exchanges between the two switching nodes of Fig. 2 for establishing a virtual path according to the method of the invention.
- Fig. 4 is the format of the control message sent from the first switching node to the second switching node.
- Fig. 5 is the format of the data frame after that the virtual path between the two switching nodes has been established by using the method according to the invention.
- Fig. 6A and Fig. 6B represent respectively the source table and the destination table of the switching nodes which are updated by a control message according to the principles of the invention.

Detailed description of the invention

As already mentioned in reference to Fig. 1, a virtual connection is established between switching node 16 and switching node 18 by using a Data Link Connection Identifier (DLCI) 992. Now, it is assumed that several virtual circuits are established between switching node 16 and switching 18 (or between two other switching nodes of Frame Relay network 14). The invention is implemented in the manner described hereafter.

Fig. 2 illustrates the implementation of the invention wherein switching node 16 is linked to the external elements via the virtual circuits VC2, VC4 on one link L0 and VC1, VC3 and VC5 on another link L1. To switching node 18 are attached virtual circuit VC1 on link L2, virtual circuit VC5 on link L3 and virtual circuits VC2, VC3 on link L4. Virtual circuit VC5

inputing switching node 16 is a connection with another switching node 24. It must be noted that the external links can be defined as ports but may be also trunks connected to other nodes of network 14.

As illustrated in Fig. 2, switching node 16 connects to switching node 26 which is a backbone node, itself connected to another backbone switching node 18, this one being finally connected to switching node 28. As illustrated in the figure, a virtual path VP 12 according to the principles of the invention is built with the virtual circuits VC1, VC2, VC3 between switching nodes 16 and 18. Virtual circuit VC5 which corresponds to a class of service different from the class of service of virtual circuits VC1, VC2, and VC3, is not aggregated in VP 12 and shows the coexistence of standards virtual circuits with virtual paths according to the invention. Note that though the invention is implemented between two switching nodes 16 and 18 including intermediary switching nodes 26 and 28, it could be implemented between two adjacent nodes as well.

It is clear that is necessary to configure correctly the assignment of each virtual circuit to its new virtual path into both switching nodes 16 and 18 as the intermediary switching nodes should remain transparent. Therefore, a protocol is defined to support the data exchange and the negotiation between the two nodes. Such a protocol is illustrated schematically in Fig. 3.

First of all control message having specific DLCI 999 is sent from switching node 16 to switching node 18. Note that value 999 is included in the values which are reserved for the layer management of the frame bearer service. On the reception of this first control message, node 18 identifies that it is the aggregation control message with the DLCI value of 999. The

node records the chain of Vcs associated to the Virtual path identification DLCIn. Node 18 answers to node 16 by :

- An aggregation control message acknowledge positive if the Virtual circuits are operational and the Quality Of Service requested in the line with the authorized parameters.
- Or a rejected aggregation control message answer. The VCs will not be operational in aggregation mode. A status message could be included in this reject message in order to identify the reason. This message will be forwarded to the network management system for filing and analysis.
- No answers from node 18 may indicate that it did not correctly understand the request. Node 16 could start an error or expiration timer when it sends a configuration control message in order to inform the network management system of this error.

In case a rejection message is received by switching node 16 or if no answer is received when the timer expires, no aggregation is performed.

An acknowledge message is then transmitted to switching node 18 in order to validate the aggregation if the confirmation is OK. Otherwise, an error or acknowledge rejection is sent by switching node 16 depending upon the message received from switching node 18. This one could also start a timer after sending its confirmation message for waiting for the acknowledge from switching node 16. In such a case, an error detection is rised at the expiration of the timer.

Fig. 4 illustrates the complete format of the control message sent from the first switching node to the second switching node in the protocol according to the invention. This control message has a defined data structure and uses a specific DLCI

(for example DLCI 999) value which has been defined as a negotiation flow between the two nodes. The assignment of this DLCI between two nodes of the network is made through the network or inter-node protocol. There could be a specific DLCI assigned for each logical connection between two nodes of the network where the aggregation needs to be activated. Each field of the control message has the following meaning :

VPID : the Trunk Virtual Path Identifier
AGGT aggregation type 14 bits (0-13)
0,1 : defines nb of bytes used for merging VC filed in data frame (1, 2 or 3 bytes) corresponds to the size of the VCID
2,3 : number of bytes for Source Port definition (6,14, 22 or 30 bits)
4,5 : number of bytes for Destination Port definition (6,14, 22 or 30 bits)
6,7 : define the size of the QoS Field : 0, 1, 2 or 3 bytes (Flow ID + QoS)
8 to 12 : indicate if it is a single command or a multiple command and in this last case, the number of VCs included
13 : bit spare

VCID : Trunk VC identifier

A control message is used to set up only one VP and one or several VCs in that VP. It must be noted that at each time one or some new VCs are established between the two nodes, a control message is sent in order to include the new VC(s) in VP. Therefore, a control message never contains many VC identifications.

In each control message, the field after DLCI 999 of 10 bits is the Virtual Path IDentifier (VPID). This field will be used as

the common DLCI N for the transmission of the frames belonging to all aggregated VCs between the two nodes.

The AGGT field of 14 bits defines the aggregation type and mode corresponding to the aggregated VCs defined after this field. It allows to align the boundary of the VCs definition to an exact number of bytes.

The Virtual Circuit Identification is put in the VCID field. This field contains as many bytes as there are VCs to be aggregated. Then, for each VC, the following fields define the Source Virtual Circuit IDentifier (corresponding to the input adapter of switching node 16), the Source Port IDentifier (corresponding to the input port switching node 16), the Destination Virtual Circuit IDentifier (corresponding to the output adapter of switching node 18), the Destination Port Identifier (corresponding to the output port of switching node 18) and the QoS field which defines Priority, Queue, Traffic type, Flow ID (per VC).

Fig. 5 shows the structure of a data frame according to the principles of the invention. The header is in fact the VP identification which fits into the DLCI field. Then, the VC identification of the VC number i, that is VCID(i) is put as the first byte of the data field which is ended by the Frame Check Sequence (FCS) field. Thanks to the control message of Fig. 4, the receiving switching node knows to which port and on which VC this data frame should be mapped.

Each time a control message is sent between the two switching nodes, an identification table shown in Fig. 6A and 6B is updated in each node. In the sending node, the source table maps, for each couple VP/VC respectively identified by VPID and VCID to the Source VC identifier and the Source Port Identifier. Similarly, in the receiving node, the destination

table maps for each couple VP/VC, to the Destination VC identifier and Destination Port identifier.

Each time a frame is received on an input adapter in switching node 16 a lookup is performed in the source table to check whether this frame should be encapsulated into a VP structure or transmitted as a normal VC frame. Similarly on the receive adapter of switching node 18 a lookup is performed on each received frame to check whether this frame is a normal VC frame which will be mapped using the classical forwarding mechanism or is a VP encapsulated frame which will be forwarded to the defined port using the defined VC given by the line pointed by this frame VP/VC identification.

Note that any virtual circuit which is no more used should be deleted from a virtual path. For this, it is possible to reserve a supplementary field in the control message (e.g. in VCID field). Another method consists in using in the first switching node, a time counter for measuring the time of non-activity of each VC. When the contents of the time counter reach a predetermined threshold, this means that the VC may be removed from the VP. If so, it is sufficient to overwrite in the source table of the first switching node, the VC identification to be removed by a new VC identification. Then, the information of removing the VC from the destination table is transmitted in an internode protocol message from the first switching node to the second switching node.

The preferred method which enables some VCs or the entire VP to be cancelled consists in using a specific control message wherein bit 13 of the AGGT field is set to 1. If all the VCID fields following the AGGT field have all their bits set to 0, this means that the entire VP is removed. If only some VCID fields have all their bits set to 0, this means that only the corresponding VCs are removed from the VP. Such a procedure can be very useful in case of re-configuration.

CLAIMS

1. Method for establishing a Virtual Path (VP) capability in a Frame Relay network wherein frames are transmitted over a plurality of virtual circuits from a first switching node (16) to a second switching node (18);

said method being characterized in that it comprises the step of transmitting from said first switching node to said second switching node a control message with a Data Link Connection Identifier (DLCI) having a predetermined value, said control message defining a virtual path aggregating at least two ones among said plurality of virtual circuits and containing the identification of the virtual circuits aggregated in said defined virtual path.

2. Method according to claim 1, wherein said control message includes a field (VCID) containing one byte for the identification of each virtual circuit aggregated in said virtual path.

3. Method according to claim 2, wherein said control message includes for each virtual circuit being aggregated in said virtual path, a portion containing a Source Virtual Circuit IDentifier (SVCID) field corresponding to the input adapter used by said virtual circuit in said first switching node (16), a Source Port IDentifier (SPID) field corresponding to the input port used by said virtual circuit in said first switching node, a Destination Virtual Circuit IDentifier (DVCID) field corresponding to the output adapter used by said virtual circuit in said second switching node (18) and a Destination Port IDentifier (DPID) field corresponding to the output port used by said virtual circuit in said second switching node.

4. Method according to claim 3, wherein said second switching node (18) transmits back to said first switching node (16) a confirmation message if the aggregation of said virtual circuits in said virtual path is possible or a rejection message if such an aggregation is not possible.

5. Method according to claim 4, wherein said first switching node (16) sends an acknowledgment message to said second switching node (18) after receiving said confirmation message.

6. Method according to claim 5, wherein a timer is started by said second switching node (18) when this one transmits back said confirmation message to said first switching node (16) in order to activate an error detection if said timer expires before said acknowledgment message has been received by said second switching node.

7. Method according to any one of claims 4 to 6, wherein a timer is started by said first switching node (16) when this one sends said control message to said second switching node (18) in order to activate an error detection if said timer expires before either said confirmation message or said rejection message has been received by said first switching node.

8. Method according to any one of claims 3 to 7, wherein said first switching node (16) includes a source table containing the values of said Source Virtual Circuit IDentifier (SVCID) and said Source Port IDentifier (SPID) for each virtual circuit aggregated in said virtual path, and said second switching node (18) includes a destination table containing the values of said Destination Virtual Circuit IDentifier (DVCID) and said Destination Port

IDentifier (DPID) for each virtual circuit aggregated in said virtual path.

9. Method according to any one of said claims 1 to 8, wherein the identification of said virtual path defined in said control message is used as Data Link Connection Identifier (DLCI) for each data frame using a virtual circuit aggregated in said virtual path.

10. Method according to any one of claims 2 to 9, wherein some ones of said VCID fields of said control message identifying virtual circuits aggregated in said virtual path contains only bits set to 0, indicating that the virtual circuits identified by said VCID fields set to 0 have to be removed from said virtual path.

11. Method according to claim 10, wherein all VCID fields of said control message are set to 0, indicating that said control path is cancelled.

12. A system comprising means adapted for carrying out the method according to any one of the preceding claims.

METHOD FOR ESTABLISHING A VIRTUAL PATH CAPABILITY IN A FRAME RELAY NETWORK

Abstract

Method for establishing a Virtual Path (VP12) capability in a Frame Relay network wherein frames are transmitted over a plurality of virtual circuits from a first switching node (16) to a second switching node (18), such a method consisting in transmitting from the first switching node to the second switching node a control message with a Data Link Connection Identifier (DLCI) having a predetermined value, this control message defining a virtual path aggregating at least two ones among the plurality of virtual circuits and containing the identification of the virtual circuits aggregated in the defined virtual path.

FIG. 2